ONTARIO MINISTRY OF ENVIRONMENT
36936000025978

TD
1066
.E84
C38
1992

Categorization (listing) background document : 2-ethoxyethanol.

82475

TD
1066
.E84
C38
1992
MOE

CATEGORIZATION (LISTING) BACKGROUND DOCUMENT

2-ETHOXYETHANOL

(CAS: 110-80-5)

ONTARIO MINISTRY OF THE ENVIRONMENT

WASTE MANAGEMENT BRANCH

HAZARDOUS WASTE REVIEW UNIT

FEBRUARY 1992

Ontario Environment Environnement

Cette publication technique n'est disponible qu'en anglais

PIBS# 1840E VOL.4

0.2M/02/92

PRINTED ON RECYCLED PAPER

TD
1066
.E84
C38
1992

Categorization (listing) background document : 2-ethoxyethanol.

82475

TABLE OF CONTENTS

1.0 SUMMARY OF BASIS FOR CATEGORIZATION 1
1.1 Listing under Regulation 309 1
1.2 Listing under other Canadian legislation 1
1.3 Listing under U.S. legislation 1

2.0 DESCRIPTION OF INDUSTRIAL SECTOR 2
2.1 Production of 2-ethoxyethanol 2
2.2 Uses of 2-ethoxyethanol 3
2.3 Production processes using 2-ethoxyethanol 4
2.3.1 Production and use of paint and coating . . . 4
2.3.2 Production and use of printing ink 4
2.3.3 Organic syntheses and miscellaneous processes 5

3.0 WASTE MANAGEMENT PRACTICES 5
3.1 Waste generation 5
3.1.1 Paint/coating production and use 5
3.1.2 Ink production and use 6
3.1.3 Organic syntheses and miscellaneous processes 6
3.2 Waste management 7

4.0 HAZARDOUS PROPERTIES OF THE WASTE 7
4.1 Hazardous properties 7
4.2 Hazardous characteristics 7
4.3 Physical and chemical properties 7
4.4 Environmental behaviour 8
4.4.1 Environmental mobility 8
4.4.2 Persistence 8
4.4.3 Bioaccumulation 8
4.4.4 Environmental exposure 8
4.5 Toxicity 8
4.5.1 Acute lethality 8
4.5.2 Sublethal effects, plants 9
4.5.3 Sublethal effects, mammals 9
4.5.4 Sublethal effects, non-mammals 9
4.5.5 Teratogenicity 9
4.5.6 Mutagenicity 10
4.5.7 Carcinogenicity 10
4.6 Results of Vector Scoring 10

5.0 CONCLUSIONS AND RECOMMENDATIONS 11

6.0 REFERENCES 19

APPENDICES
A: U.S. Regulations
B: Justification of vector scoring
C: Proposed Amendments to Regulation 309

LIST OF TABLES

TABLE		PAGE
1.	Estimated use of 2-ethoxyethanol in 1987	12
2.	Ontario paint and varnish formulation establishments reporting to Statistics Canada	13
3.	Ontario printing ink formulation establishments reporting to Statistics Canada	14
4.	Estimated waste generation rate in Ontario	15
5.	Selected Physical Properties of 2-Ethoxyethanol	16
6.	Acute Toxicity of 2-Ethoxyethanol	17
7.	Results of vector scoring of 2-ethoxyethanol	18

1.0 SUMMARY OF BASIS FOR CATEGORIZATION

1.1 Listing under Regulation 309

The Ontario Ministry of the Environment (M.O.E.) is considering amending Regulation 309 and listing 2-ethoxyethanol in Schedule 1 (as a hazardous industrial waste) and Schedule 2B (as a hazardous waste chemical).

This listing would be achieved in two ways:

a) when 2-ethoxyethanol (or mixture of it) is disposed of as a spent solvent or as still bottoms from the recovery of that same solvent, the waste should be listed in Schedule 1, paragraph NA 9305;

b) when 2-ethoxyethanol (or mixture of it) is disposed of as an off-specification commercial chemical or as a manufacturing chemical intermediate, the waste would be listed as a hazardous waste chemical in Schedule 2, Part B.

2-ethoxyethanol exhibits the hazardous characteristic of ignitability and has been shown to be teratogenic in animals (causing skeletal abnormalities and cardiovascular malfunction). In addition, conclusive evidence of mutagenicity has been found in animals (hamsters ovary cells). Due to its mobility and persistence in ground water 2-ethoxyethanol may create a health hazard in drinking water, if waste contaminated with this chemical is improperly managed and allowed to enter the environment.

1.2 Listing under other Canadian legislation

Under the federal Transportation of Dangerous Goods Act (TDGA), 2-ethoxyethanol (with a flash point of 42.7°C) is classified as a flammable liquid (Class 3.3, if a liquid has a flash point between 23°C and 61°C, it is identified as moderately flammable for international air transport and international marine transport of waste). The chemical is not listed as an environmentally hazardous substance, or a miscellaneous dangerous good.

1.3 Listing under U.S. legislation

2-ethoxyethanol waste has been listed in the U.S. "Resource Conservation and Recovery Act" (RCRA) as a hazardous waste if disposed of as a spent solvent or as still bottoms from the recovery of that solvent. Spent solvent has been defined in the U.S. legislation as follows:

a) the original chemical mixture must be used for its solvent properties (i.e. it dissolves or mobilizes constituents);

b) the chemical mixture must be spent;

c) before use (i.e. at the commercial stage) the chemical mixture must have a total concentration of 10 percent or more of the listed constituents (see Appendix A).

2.0 DESCRIPTION OF INDUSTRIAL SECTOR

2-ethoxyethanol (synonyms: cellosolve, ethyl glycol) is a general solvent slightly lighter than water and ignitable in its pure form or at high concentration in a waste mixture (see table 5).

The major uses of 2-ethoxyethanol in Canada (and presumably in Ontario) are in the production and use of paints and coatings, and in the production and use of inks (Cerf, 1988).

2.1 Production of 2-ethoxyethanol

In the United States, 2-ethoxyethanol is currently produced on a commercial scale by the following companies (USEPA, 1985):

Eastman Kodak (Texas Eastman)	Longview,Tx.
ICI Americas	Bayport, Tx.
Shell Oil Co.	Geismar, La.
Texaco	Port Neches, Tx.
Union Carbide	Penuelas, Puerto Rico.

The end uses of 2-ethoxyethanol, as a solvent, are estimated in Table 1:

88% for protective coatings,
6% for printing inks, and
6% for other solvent uses.

In Canada, 2-ethoxyethanol is neither produced nor used as a chemical intermediate (Cerf, 1988; Healey, 1988). A total of 857 tonnes was imported in 1987 (Statistics Canada, 1987). Eastman Chemicals Ltd. and Union Carbide Canada Ltd. are the major importers. As of September 1, 1988, Eastman Chemicals Ltd. has reported that they no longer supply 2-ethoxyethanol (Healey, 1988). Union Carbide Canada Ltd. forecasts that it will import a total of 420 tonnes in 1989 (Cerf, 1988). The distributors are Canada Colours and Chemicals Ltd., Van Waters & Rogers Ltd., Ashland Chemicals/Solvent Div., and Harrison and Crossfield (Canada) Ltd.

In canvassing the Canadian suppliers and distributors of 2-ethoxyethanol, the following information was obtained about the end uses:

1) Union Carbide Canada Ltd. - major end uses were in the paint, coating and ink industry;

2) Canada Colours And Chemicals Ltd. - out of 32 accounts in Ontario, 9 accounts were with the paint and coating industry, 3 accounts were with the ink industry and the remaining in various others. The major volume was in the first two categories;

3) Van Waters & Rogers - the following were the reported end uses:

Coatings:	6%
Inks:	4%
Resins:	39%
Compounders	39%
Others	12%

If resins and compounders are classified as protective coatings, the distribution is as follows:

Protective coatings:	84%
Printing inks:	4%
Other solvent uses:	12%

The following information on sales of 2-ethoxyethanol has been reported in Ontario for 1987:

Canada Colours and Chemicals Ltd.	70.5 tonnes
Van Waters & Rogers Ltd.	54.0
Ashland Chemicals/Solvent Div.	32.0 (minimum)
Total	156.5

The total represents only 52% of the estimated uses in Ontario. A more realistic quantity of 300 tonnes is used in this review.

2.2 Uses of 2-ethoxyethanol

2-ethoxyethanol is widely used in nitrocellulose lacquer, epoxy coatings, phenolic varnishes, and varnish removers (SRI, 1981). It is an excellent solvent for nitrocellulose and alkyd resins.

2-ethoxyethanol is used as a solvent in printing inks (flexographic and rotogravure) to control the drying rate during printing (Kirk-Othmer, 1979). In other minor applications, 2-ethoxyethanol is used in adhesives, dyestuffs, metal and glass cleaners, hydraulic brake fluids, laboratory experiments, and as a medium for miscellaneous pharmaceutical reactions and purifications (SRI, 1981). 2-ethoxyethanol is also used in the finishing of leather with water pigments and dye solutions (Windholz, 1983).

2.3 Production processes using 2-ethoxyethanol

2.3.1 Production and use of paint and coating

The shipment of solvent-based paints, enamels, stains, lacquers, primers, and paint thinners for 1984 was 200,688,000 litres (Statistics Canada, 1985a), i.e. 200,688 tonnes (assuming a density of 1 kg/l). The quantity shipped in Ontario is estimated at 70,240 tonnes (relative population of 35%). Table 2 identifies the companies reporting to Statistics Canada on their shipments for 1984.

C-I-L Paints indicates, in its Generator Registration Report (GRR, 1988), that its wastes are off-specification products, solvent from equipment cleaning and rinses in its manufacturing process.

2.3.2 Production and use of printing ink

Ink consists of colouring matter (a dye or pigment) dispersed in a base which may be an oil, solvent or water. Flexographic and gravure inks (solvent and water based formulations) may contain 2-ethoxyethanol as additive to modify drying rates. In 1984, flexographic and rotogravure inks represented 16% and 12%, respectively, of a total ink sale of 57,502 tonnes (Statistics Canada, 1985b). The Ontario establishments, which reported shipments of ink to Statistics Canada, are identified in Table 3.

The Generator Registration Reports (GRR, 1988) of the printing ink establishments listed in Table 3 were reviewed. The information collected indicates that the major sources of waste are off-specification batches and spent solvent (equipment cleaning wastes and still bottoms from the recovery of the solvent). Other wastes include rinse water from equipment cleaning and wastewater treatment sludge.

Sinclair & Valentine Inc. indicates that its registered waste arises from the cleaning of equipment and pans (GRR, 1988). The principal solvents used at the facility are as follows (not necessarily in the order of consumption):

Toluene	Isopropyl Alcohol
Acetone	Normal Propanol
2-Ethoxyethanol	Isopropyl Acetate
Methyl-ethyl ketone	Normal Propyl Acetate
Ethanol	

Printing shops produce spent solvent from cleaning operations and condensate from solvent vapour recovery. Solvent enters the printing press as a component of the ink and as a cleaning solvent between runs. Usually the base solvent is added to the ink at the press. Almost all the solvent evaporates at the press. Recovery of the solvent vapour is usually done by carbon absorption followed

with distillation to produce a condensate. Recovery is typically 17%. Equipment cleaning wastes are generated periodically with solvent concentration ranging from 50 to 100%.

2.3.3 Organic syntheses and miscellaneous processes

In these processes, the solvent acts as a medium in which a reaction takes place, or serves to extract, separate, or purify a material from a mixture. 2-ethoxyethanol has been used in the production of phenolic and epoxy-resin in miscellaneous pharmaceutical reactions and extractions.

The primary sources of liquid waste containing significant amount of 2-ethoxyethanol are spent solvents from process equipment clean-up and still bottoms from solvent recovery. Other wastes, which contain very low concentration of solvent, are wastewaters from equipment cleaning and sludges from treatment of these wastes.

3.0 WASTE MANAGEMENT PRACTICES

3.1 Waste generation

Wastes contaminated with 2-ethoxyethanol are generated from the production and use of paint/coating, ink and other organic materials. Table 4 presents a summary of the estimated quantities of waste generated in the different sectors.

3.1.1 Paint/coating production and use

The amount of waste generated from the production and use of paint is estimated from generation factors developed by USEPA (1985b):

1) spent solvent and recovery still bottoms are generated at a rate of 0.047 kg per kg of paint produced; the quantities of spent solvent and still bottom are approximately equal (i.e. the generation rate of spent solvent alone is 0.0235 kg per kg of paint produced);

2) off-specification products are generated at a rate of 0.018 kg per kg of paint produced.

For paint based on 2-ethoxyethanol the solvent typically represents 32% of the total volume of paint (USEPA, 1985b). With the use of 264 tonnes of 2-ethoxyethanol in Ontario (Table 1), the total production of 2-ethoxyethanol-based paints is approximately (264/0.32) = 825 tonnes. The estimated amount of spent solvent and recovery still bottoms is 825 x .047 = 38.8 tonnes (i.e. 19.4 tonnes respectively). Off-specification products generation is estimated to be 825 x 0.018 = 14.9 tonnes per year.

From the Generator Registration Reports (GRR, 1988), the paint and varnish industry (SIC code #3751) has registered an estimated total of 5,801 tonnes of waste (waste class coded 145H: 145 indicating waste from the use of paints, pigments and coatings, and H indicating a listed waste). Nearly 95.4% (5532 tonnes out of 5801) of the waste is registered from U.S. generators. The remaining 269 tonnes are from Ontario generators (see Table 2). These figures do not represent in any way the actual amount of waste disposed of in Ontario from either U.S. or Ontario generators. The difference between the two estimates (53.7 tonnes from generation factors and 269 tonnes from GRR) is due to a number of factors, the most important being the broad definition of the waste class code.

3.1.2 Ink production and use

In order to estimate the quantity of spent solvent and still bottoms generated from ink formulation, the process is assumed to closely resemble the one in production of paints, as discussed in Section 3.1.1. The concentration of 2-ethoxyethanol is taken to be 28%, based on the estimated range of 25 to 30%, (Whittenburg, 1988).

Regarding the emission rate of spent solvent and still bottoms, the following Ontario information confirms the USEPA factor: 5,882 tonnes of rotogravure and flexographic ink were shipped in Ontario (based on 35% of the total Canadian shipment of 16,340 tonnes). Based on the Generator Registration Reports (GRR, 1988) and SIC code 3791 (printing ink) a total of 235.4 tonnes of waste is produced in Ontario. If it is assumed that all the waste is solvent based, the emission factor is estimated to be (235.4/5882) = 0.040. This agrees quite well with the USEPA factor of 0.047 indicated in section 3.1.1.

With the use of 18 tonnes of 2-ethoxyethanol in Ontario (Table 1), the total production of 2-ethoxyethanol-based ink is approximately (18000/0.28) = 64,300 kg. The estimated amount of spent solvent and recovery still bottoms was 64,300 x .047 = 3,000 kg, representing 1.5 tonnes of spent solvent and 1.5 tonnes of still bottoms. The generation rate of off-specification products is estimated to be 64,300 x .018 = 1,157 kg (approximately 1.2 tonnes).

3.1.3 Organic syntheses and miscellaneous processes

In order to estimate the quantity of waste generated in this sector, emission rates based on the U.S. listing document for spent 2-ethoxyethanol (USEPA, 1985) were used:

1) the amount of 2-ethoxyethanol lost in the liquid waste is 60% of the total amount of new solvent purchased. This is based on a study that 40% of benzene (a solvent used in applications similar to those of 2-ethoxyethanol) purchased by the

pharmaceutical industry is lost as gaseous emissions and as residue on the product (USEPA, 1980);

2) the concentration of 2-ethoxyethanol in the liquid waste stream is 75%. This is based on ranges for benzene and 2-ethoxyethanol in the Industry Studies Data Base (USEPA, 1984);

3) the above evaluation is used for miscellaneous uses as well as for the organic synthesis sector;

4) distillation of spent 2-ethoxyethanol generates approximately 70% refined solvent and 30% still bottoms (NASR, 1982).

With the use of 18.0 tonnes of 2-ethoxyethanol in Ontario (Table 1) it is estimated that 14.4 tonnes (i.e. (18.0 x .6) /.75) of waste are generated. 70% or 10.1 tonnes are recovered, leaving 4.3 tonnes of wastes containing 17% 2-ethoxyethanol.

3.2 Waste management

Management of waste containing 2-ethoxyethanol, such as cleaning waste and off-specification products from paint and ink formulation, includes contract hauling to landfill, incineration, burning in boilers, discharge to wastewater, and solvent recovery (USEPA, 1985b).

Data from the Generator Registration Reports (GRR, 1988) indicate that the hazardous waste from the paint and ink formulation industry is disposed of at secured landfill sites.

4.0 HAZARDOUS PROPERTIES OF THE WASTE

4.1 Hazardous properties

In a spent solvent, 2-ethoxyethanol is typically present at concentrations ranging from 50% to 90%. In the still bottoms from recovery operations, this solvent is present at concentrations ranging from 1% to 20% (USEPA, 1985b). At these concentrations, the waste toxicity would be similar to the toxicity of 2-ethoxyethanol.

4.2 Hazardous characteristics

With a flash point of 42.7 °C, pure 2-ethoxyethanol is considered ignitable under section 1 (29) of Regulation 309. Depending on the concentration of 2-ethoxyethanol in the waste, the waste may also be ignitable.

4.3 Physical and chemical properties

Selected physical and chemical properties of 2-ethoxyethanol are listed in Table 5.

4.4 Environmental behaviour

4.4.1 Environmental mobility

Environmental mobility refers to the multimedia partitioning in this paragraph. Using the Fugacity Model (Level 1) (Mackay et al., 1982), it is estimated that 99.5% of 2-ethoxyethanol would be dispersed in a water medium. Since the expected dispersion is in one medium, the concern level is low.

4.4.2 Persistence

2-ethoxyethanol does not react with water in the pH range of 2 to 14. 2-ethoxyethanol is not directly photolysed in the lower atmosphere or near the surface of water bodies. 2-ethoxyethanol, belonging to the structural class of ethers, is rapidly attacked by hydroxyl radicals in the atmosphere.

2-ethoxyethanol is expected to be moderately persistent in ground water because of its resistance to hydrolysis and the relatively low level of biological activity in ground water (U.S. Federal Register, 1985).

4.4.3 Bioaccumulation

Based on a log octanol/water ratio of -0.10, a calculated bioconcentration factor (BCF) of 0.5 is obtained using the relationship developed by Veith et al. (1980). It is expected that bioaccumulation in aquatic organisms is not significant.

4.4.4 Environmental exposure

Most of the waste containing 2-ethoxyethanol is landfilled or incinerated. Since 2-ethoxyethanol is completely mixable with water, leaching from a contaminated waste would be highly likely. It is also expected that, with an estimated soil absorption coefficient (koc) of 113, moderate attenuation may occur (USEPA, 1985). With a resistance to hydrolysis and a relatively low level of biological activity in ground water, it is expected that 2-ethoxyethanol is moderately persistent (U.S. Federal Register, 1985). Therefore contamination of groundwater aquifers could result from the mismanagement and improper disposal of 2-ethoxyethanol waste. Contamination of groundwater would increase significantly the risk of adverse effects on human health and the environment.

4.5 Toxicity

4.5.1 Acute lethality

The acute effect of 2-ethoxyethanol in a number of species are summarized in Table 6. Pathological examination in numerous studies revealed hemorrhage in the gastrointestinal tract, extreme kidney

injury, moderate liver damage and hematuria in mice, rats and guinea pigs (USEPA, 1985).

4.5.2 Sublethal effects, plants

Decreased cell multiplication was observed with blue-green algae at the exposure concentration of 100 mg/l (Acquire, 1988).

4.5.3 Sublethal effects, mammals

In a 90-day study, 0.25% 2-ethoxyethanol in the diet had no effect (Rowe and Wolfe, 1982). Stenger et al. (1971) fed rats for 13 weeks at a no-effect-level (NOEL) of 93 mg/kg/day.

Slight effects on cellular elements of the blood were found by Barbee et al. (1984) in their study where rats and rabbits were exposed to 0, 25, 100 and 400 ppm (6 hours/day, 5 days/week, for 13 weeks). Only in the 400 ppm group was there a dose related decrease in weight gain (USEPA, 1985).

Melnick (1984) established a Lowest Observed Adverse Effect Level (LOAEL) of 357 mg/kg/day for rats in a 103-week study. The effects at that level were reduced body weight in male and female rats, and possibly enlarged adrenals in male rats. The USEPA (1985) established a No Observed Adverse Effect Level (NOAEL) of 35.7 mg/kg/day by dividing the LOAEL by an uncertainty factor of 10.

4.5.4 Sublethal effects, non-mammals

The No Observed Effect Concentration (NOEC) for fish, derived from QSAR modeling (Quantitative Structure Activity Relationship), has been calculated at 2582 mg/l (HCCB, 1988).

4.5.5 Teratogenicity

Hardin et al. (1982) tested the teratogenic effects of dermally applied 2-ethoxyethanol in SPF Sprague-Dawley rats. Undiluted 2-ethoxyethanol was applied to the shaved interscapular region 4 times/day, at a dose of 2.0 ml/day and 1.0 ml/day during gestation days 7-16. Only 52% of the dams exposed to the low 2-ethoxyethanol dose had live fetuses, and the number of live fetuses per litter and the mean fetal weights were severely depressed. In the high dose group, the fetuses had significant increased incidence of cardiovascular and renal anomalies. Three fetuses also exhibited imperforate anus and acaudia.

2-Ethoxyethanol is teratogenic when administered by gavage at the LD-10 maternal dose. At this dose, there were no viable litters (Andrew and Hardin, 1984). When given by gavage to mice, a high incidence of malformations as well as increased post-natal mortality were observed (Weir et al., 1987).

The vector score of 6 (see Table 7 and Appendix B) is based on a study reporting that rats, exposed to 2-ethoxyethanol by inhalation on the 6-15 day of gestation at 10 ppm for 6 hours per day (dose of 5.45 mg/kg/day), developed muscle and skeletal abnormalities on the offsprings (RTEC, 1981).

4.5.6 Mutagenicity

In a plate incorporation assay using Salmonella Typhimurium strain TA1537, TA1535, TA100 and TA98 with and without S-9 from Aroclor-induced rats, 2-ethoxyethanol did not produce reversions at concentrations up to 23 mg/plate (Ong, 1980). Ong et al. (1980), using the same strain of Salmonella Typhimurium with and without metabolic activation, also observed no excess reversion at concentrations up to 20 ul per plate. Similar results were obtained by Zeiger et al. (1982) who used the same strains of Samonella Typhimurium, S-9 from Aroclor 1254-induced male rats and hamsters and 2-ethoxyethanol dissolved in water at concentrations of 10-25 ul/plate. Kawalek and Andrews (1980) also obtained negative results using strain TA1538.

Mutagenicity tests in a mammalian cell culture system (Chinese Hamster Ovary cells) show that 2-ethoxyethanol can induce sister chromatid exchanges (SCE) and chromosome aberrations without a bioactivation system (Galloway et al., 1987).

The vector score of 8 (Table 7 and Appendix B) is based on recent findings of Galloway et al. (1987).

4.5.7 Carcinogenicity

In a 2-year study conducted by the National Toxicology Program in which male and female rats were exposed to 2-ethoxyethanol by gavage, no increased incidence of tumors was reported (Melnick, 1984).

4.6 Results of Vector Scoring

A vector scoring system for waste categorization and review has been developed to evaluate the exposure and toxicity of waste to human health and the environment. The results of the vector scoring for 2-ethoxyethanol are shown in Table 7. Details of the scoring procedure are presented in the guidance manual (MOE, 1991).

The teratogenic effects of 2-ethoxyethanol are the main concerns for human health. The environmental parameters of concern are the mobility and moderate persistence of this chemical. Leaching to groundwater and contamination of drinking water is highly possible. The justification for scoring is included in Appendix B.

5.0 CONCLUSIONS AND RECOMMENDATIONS

With an estimated use of 300 tonnes of 2-ethoxyethanol in Ontario (in 1987), spent solvent is generated at an estimated rate of 35.3 tonnes yearly. Still bottoms from solvent recovery and waste off-specification products are estimated at a rate of 25.2 and 16.1 tonnes per year respectively. The spent solvent may contain 75% 2-ethoxyethanol. The still bottoms may contain up to 20% and the off-specification products, a maximum of 50%. Thus, if the above wastes were to be mismanaged, a total of 39.6 (0.75x35.3 + 0.20x25.2 + 0.50x16.1) tonnes of 2-ethoxyethanol could be released annually to the environment. However, under proper management (as defined in Regulation 309), spent solvents and still bottoms from the recovery of these solvents would be either recycled or incinerated at licensed hazardous waste disposal sites.

The potential release (environmental exposure) of waste contaminated with 2-ethoxyethanol in the environment presents a serious hazard because of the high concentration of 2-ethoxyethanol in the waste and because of the teratogenic and mutagenic effects of 2-ethoxyethanol.

The above consideration, justifies that 2-ethoxyethanol be listed in Schedule 1 and Schedule 2, part B of Regulation 309 (see Appendix C).

(File: GC:\LIST\2EE\D081291.DOC)

Table 1: Estimated use of 2-ethoxyethanol in 1987

Uses	Percent of total used(1)	Quantity used in Canada (Tonnes/yr)	Quantity used in Ontario(2) (Tonnes/yr)
Protective coatings	88	754.2	264.0
Printing Inks	6	51.4	18.0
Other solvents	6	51.4	18.0
TOTAL:	100	857.0(3)	300.0

(1) Source: USEPA, 1985b

(2) Based on a relative population of Ontario (35%)

(3) Import 1987 (Statistics Canada, 1987)

Table 2: Ontario paint and varnish formulation establishments reporting to Statistics Canada

AKZO COATINGS LTD., ETOBICOKE
ALLCOLOURS PAINT & CHEMICALS, OAKVILLE
ALMATEX INC., LONDON
BAPCO, (CENTRE), VAUGHAN
BENJAMIN MOORE & CO. LTD., TORONTO
C-I-L INC. (PAINT WORKS), YORK
COLOUR YOUR WORD INC., ETOBICOKE
CUPRINOL KORZITE LTD., GUELPH
DESOTO COATINGS LTD., ETOBICOKE
DU PONT CANADA INC., (PAINT DIV.), AJAX
DUPLI-COLOR CANADA LTD., SCARBOROUGH
DUSSEK CAMPBELL LTD., BELLVILLE
IBIS PRODUCTS LTD., SCARBOROUGH
IBIS PRODUCTS LTD., NIAGARA FALLS
IMCO INDUSTRIAL & MARINE COATINGS LTD., DUNDAS
INMONT CANADA INC., (AUTOMOTIVE GROUP), BRANTFORD
INMONT CANADA INC., (AUTOMOTIVE GROUP), WINDSOR
INTERNATIONAL PAINTS (CANADA) LTD., (ROXLIN OF CANADA DIV.)
IROQUOIS CHEMICAL CORP. (COATING DIV.), CORNWALL
K & G PACKING LTD., EAST YORK
KELCOATING LTD., WESTMINISTER
LAWTER INTERNATIONAL (CANADA) LTD. (ROXALIN OF CANADA DIV.)
MACDONALD & WHITE VARNISH & PAINT CO. LTD., WINDSOR
NIAGARA PAINT CHEMICAL CO. LTD., HAMILTON
NUODEX COLORTREND LTD., BRAMPTON
PARA PAINTS CANADA INC., ETOBICOKE
PPG CANADA INC., MISSISSAUGA
PRATT & LAMBERT INC., FORT ERIE
RUST-OLEUM (CANADA) LTD., NORTH YORK
S C M (CANADA) LTD./LIMITEE GLIDDEN DIV.), TORONTO
S C M (CANADA) LTD./LIMITEE GLIDDEN DIV.), BRAMPTON
SCHWARTZ CHEMICAL OF CANADA LTD., PICKERING
SELECTONE PAINTS LTD., NORTH YORK
SICO INC. (REXDALE), ETOBICOKE
SOLIGNIUM INC., YORK
STERLING LTD., ST. CATHARINES
TECHNICAL COATINGS CO. LTD., BURLINGTON
VALSPAR INC., (COATING DIV.), SCARBOROUGH

Source: Statistics Canada, 1985a, SIC #3751

Table 3: Ontario printing ink formulation establishments reporting to Statistics Canada

B C M INKS LTD., BRAMPTON
C F C LIQUID INKS LTD., ETOBICOKE
CANADIAN FINE COLOURS CO. LTD., NORTH YORK
CANADIAN FINE COLOURS CO. LTD., LONDON
CONVERTERS INK (CANADA) LTD., NORTH YORK
GENERAL PRINTING INK CORPORATION, NORTH YORK
GENERAL PRINTING INK CORPORATION, BURLINGTON
HOSTMANN-STEINBERG CANADA LTD., SCARBOROUGH
IMMONT CANADA INC., (GRAPHICS GROUP), SCARBOROUGH
IMMONT CANADA INC., (GRAPHICS GROUP), TORONTO
IMMONT CANADA INC., (PETERS ST-GRAPHICS GROUP), BRAMPTON
IMMONT CANADA INC., (GRAPHICS GROUP), LONDON
INTER-PROVINCIAL INKS LTD., VAUGHAN
JOHNSON & BLOY CANADA INC., MISSISSAUGA
LESTER INK & CHEMICALS LTD., MARKHAM
MONARCH INKS COMPANY LTD., TORONTO
NAZ-DAR CANADA LTD., YORK
PPG CANADA INC. (BOWERS PRINTING INK DIV.), MARKHAM
REIGER FLEXO & GRAVURE LTD., NORTH YORK
REIGER PRINTING INK CO. LTD., NEPEAN
REIGER PRINTING INK CO. LTD., TORONTO
REIGER PRINTING INK CO. LTD., BURLINGTON
REIGER PRINTING INK CO. LTD., LONDON
SINCLAIR VALENTINE-FRYE LTD., NORTH YORK

Source: Statistics Canada, 1985b, SIC #3791

Table 4: Estimated waste generation rate in Ontario
[tonnes/year]

Waste	Paint & Coating Production	Ink Production	Organic Syntheses & Miscellaneous Processes	Total
Spent Solvent	19.4 (50-100)	1.5 (50-100)	14.4 (75)	35.3
Recovery still bottoms	19.4 (1-20)	1.5 (1-20)	4.3 (1-20)	25.2
Off specification product	14.9 (15-50)	1.2 (10-20)		16.1

"( )" : range of 2-ethoxyethanol concentration in waste (%)

Table 5: Selected Physical Properties of 2-Ethoxyethanol

Chemical Abstract #	: 110-80-5
Chemical Abstract Name	: 2-ethoxyethanol
Synonyms	: ethylene glycol monoethyl ether, glycol ethyl ether, ethyl glycol, hydroxy ether,
Trade Names	: Dowanol 2-ethoxyethanol, Cellosolve, Oxitol, Poly-solo 2-ethoxyethanol.
Chemical Formula	: $C_4H_{10}O_2$
Molecular Weight	: 90.1
Boiling Point	: 135.5 °C
Melting Point	: -70 °C
Density	: 0.928 g/cc.
Solubility	: complete
Volatility	: 3.8 mm Hg at 20 °C
Log k_{ow}	: -0.10
Flash point (TCC)	: 42.7 °C
Conversion Factor	: 1ppm = 3.75 mg/m^3

Table 6: Acute Toxicity of 2-Ethoxyethanol

Route	species	Dose (g/kg)	Response	Reference
Oral	rats	3.0	LD_{50}; death delayed 1 week	Union Carbide, 1976
	rats (male)	2.3	LD_{50}; 14-day observation period	Cheever et al., 1984
	rats	1.89	LD_{50}	Patty, 1963
	mice	4.8	LD_{50}	Stenger et al., 1971
	rabbits	1.5	LD_{50}	Stenger et al., 1971

Table 7: Results of vector scoring of 2-ethoxyethanol

Parameter	Score	Concern Levels+
1. Environmental Mobility	0	≥ 7
2. Environmental Persistence	4	≥ 7
3. Bioaccumulation	0	≥ 7
4. Environmental Exposure	7	≥ 7
5. Acute lethality	2	≥ 6
6. Sublethal effects plants	0	≥ 4
7. Sublethal effects mammals	2	≥ 4
8. Sublethal effects non-mammals	0	≥ 4
9. Teratogenicity	6	≥ 2
10. Mutagenicity	8	≥ 6
11. Carcinogenicity	0	≥ 2

+ : concern levels established for the listing of hazardous wastes.

6.0 REFERENCES

Acquire, 1988 USEPA database, vendor CIS.

Andrew, F.D., and Hardin, B.D., 1984. Developmental effects after inhalation exposure of gravid rabbits and rats to ethylene glycol monomethyl ether. Environ. Health Perspect. 57: 13-23.

Barbee et al., 1984, Subchronic inhalation toxicology of ethylene glycol monoethyl ether in the rat and rabbits. Environmental Health Perspect. 57:157-613.

Cerf, J., 1988, Manager, Product Safety and Environmental Protection, Union Carbide Canada Ltd., personal communication.

Cheever K.L., et al., 1984, Metabolism and excretion of 2-ethoxyethanol in the adult male rat., Envir. Health Perpect. 57: 241-248.

Galloway, S.M., Armstrong, M.J., et al., 1987. Chromosome aberrations and sister chromatid exchanges in Chinese Hamster Ovary cells: evaluations of 108 chemicals. Environ. Molec. Mutagenesis 10 (Suppl. 10): 1-175.

GRR, 1988, Generator Registration Reports. Copies are available at the Waste Management Branch, Ontario Ministry of the Environment, 2 St. Clair Avenue West, Toronto, Ontario, M4V 1L5.

Hardin et al., 1982. Teratogenicity of 2-ethoxyethanol by dermal application. Drug and Cosmetic Toxicol 5(3), 277-294.

Hardin, Bryan D., Schuler, Ronald L., Burg, JeAnne R., Booth, Gary M., Hazelden, Keith P., MacKenzie, Karen M., Piccirillo, Vincent J., and Smith, Kirby N., 1987. Evaluation of 60 chemicals in a preliminary developmental toxicity test. Teratog., Carcinog., Mutagen., 7(1), 29-48.

HCCB, 1988, Preliminary Assessment of 2-ethoxyethanol for EMMPL listing. Hazardous Contaminants Coordination Branch, MOE.

Healey, M., 1988, of Eastman Chemicals Ltd., personal communication.

Kawalek J.C. and A.W. Andrew, 1980, The effect of solvent on drug metabolism in vitro., Drug Metab. Dispos. 8(6)380-384.

Kirk-Othmer, 1979. Encyclopedia of Chemical Technology. Third Edition, John Wiley and Sons, New York, New York.

Mackay, D. and Paterson, S., 1982. Fugacity revisited. Env. Sc. and Tech., Vol.16, No.12, 1982.

Melnick R.L., 1984. Toxicity of ethylene glycol and ethylene glycol monoethyl ether in Fischer 3434/N rats and B6C3F1 mice. Environmental Health Perspect 57: 147-155.

MOE, 1991, Guidance Manual for Hazardous Waste Categorization and Review Program. ISBN 0-7729-7960-X, PIBS 1402. Copy available at the Waste Management Branch, Ontario Ministry of the Environment, 2 St. Clair Avenue West, Toronto, Ontario, M4V 1L5.

NASR, 1982. Solvent recycling industry survey. National Association of Solvent Recyclers, as cited in USEPA (1985).

Ong T., 1980, Mutagenicity Testing of 2-Ethoxy/Methoxy Ethanol. NIOSH Internal Communication. September 29 (Cited in USEPA, 1985).

Ong et al., 1980, Mutagenicity Testing of selected industrial chemicals. Proceedings of the first NCI/EPA/NIOSH Collaborative Workshop: Progress on Joint Environmental and Occupational Cancer Studies. May 6-8, Rockville, Md. (Cited in USEPA, 1985).

Patty, F.A., 1963. Industrial Hygiene and Toxicology, Vol. 3, Interscience Publishers, N.Y.

Rowe and Wolfe, 1982, Derivatives of glycols. In: Patty's Industrial Hygiene and Toxicology,#3rd rev. ed. Vol.2, G.D. Clayton and F.E. Clayton, Ed. John Wiley and Sons Inc., N.Y., p3909-4052.

RTEC, 1981, Registry of Toxic Effects of Chemical Substances, edited by R.L. Tatken and R.J. Lewis., NOISH, Cincinnati, 1983.

SRI, 1981, SRI International. Chemical Economic Handbook. Menlo Park, California.

Statistics Canada, 1985a, Chemical and chemical products industries, Annual Census of Manufactures, Cat. 46-250, p27-29

Statistics Canada, 1985b, Chemical and chemical products industries, Annual Census of Manufactures, Cat. 46-250, p31

Statistics Canada, 1987, International Trade Division, Imports Commodity by Country, C.I. T. C. Detail, 1986-1987, commodity #40832-26.

Stenger et al., 1971, The toxicity of ethylene glycol monoethyl ether . Arzneim-Forsch 21(6): 880-885.

Union Carbide, 1976, Glycol ethers, Technical brochure F-415244c. October, 1976, Union Carbide Corp., New York, p26-27.

USEPA, 1980. Pharmaceutical production. Compilation of air pollutants emission factors, supplement 11, third edition, Research Triangle Park, North Carolina, as cited in USEPA (1985).

USEPA, 1984. Non-confidential data from the Industry Studies Data Base. JRB Associates, McLean, Virginia, as cited in USEPA (1985).

USEPA, 1985, Research and Development, Health and Environmental Effects, profile for 2-ethoxyethanol. Prepared for the Office of Solid Waste and Emergency Response. Prepared by Environmental Criteria and Assessment Office Cincinnati, OH45268.

USEPA, 1985b, Listing Background Document For Four Spent Solvents and Still Bottoms from Recovery of these Solvents. Prepared by Walter Bauer of Dynamac Corporation for the Office of Solid Waste. U.S. Environmental Protection Agency. Contract# 68-01-6804.

U.S. Federal Register, 1985, Proposed Rule, Vol. 50, July 30, 1985, p30908-30913.

Veith, G.P., et al., 1980, An Evaluation of Using Partition Coefficient and Water Solubility to Estimate Bioaccumulation Factors for Organic Chemicals in Fish, IN: Aquatic Toxicology, Eaton J.G. et al. (Eds.), American Society for Testing Materials, Philadelphia, P.A., ASTM 707.

Whittenburg, H., 1988, Secretary.-Treasurer of the Canadian Printing Ink Manufacturers' Association, personal communication.

Wier, Patrick J., Lewis, Steven C., and Traul, Karl A., 1987. A comparison of developmental toxicity evident at term to postnatal growth and survival using ethylene glycol monoethyl ether, ethylene glycol monobutyl ether, and ethanol. Teratog., Carcinog., Mutagen., 7(1), 55-64.

Windholz, 1983, The Merch Index, Tenth Edition, Merch & Co., Rahway, N.J.

Zeiger E., et al., 1982, Phthalate ester testing in the National Toxicology Program's Environmental Mutagenesis Test Development Program., Environ. Health Perspect. 45:99-101.

Appendix A:

U.S. Regulation

The USEPA has defined spent solvents as those solvents that are used for their "solvent" properties, that is to solubilize (dissolve) or mobilize other constituents (for example, solvents used in degreasing, cleaning, fabric scouring, as diluents, extractants, reaction and synthesis media). A solvent is considered "spent" when it has been used and is no longer fit for use without being regenerated, reclaimed or otherwise reprocessed.

The listing of spent solvents was originally drafted with the intention to include technical grade or pure forms of the solvent. On December 31, 1985, the listed solvents were to include mixtures containing ten percent or more of the total listed solvents. The ten percent threshold applied to solvent mixtures, before use. The agency took this position based on data which indicate that solvent mixtures, used in commerce, typically contain more than ten percent total solvents.

Source:

U.S. Federal Register, Final Rule, Vol. 51, Feb. 25, 1986, p.6537-6542.

Appendix B:

Justification for vector scoring of 2-ethoxyethanol

Parameter	Score	Justification
1. Environmental Mobility	0	Using the level 1 fugacity model 99.5% would partition in water.
2. Environmental Persistence	4	Based on half-life of 2-15 days (QSAR).
3. Bioaccumulation	0	Calculated BCF of 0.5.
4. Environmental Exposure	7	Because of easy pathway between the contaminants sources and receptor.
5. Acute lethality	2	LC_{50} = 6825 mg/m^3 (1820 ppm) (Inhalation).
6. Sublethal effects, plants	0	Decreased cell multiplication was found with b-g algae at 100 mg/l.
7. Sublethal effects, mammals	2	LOAEL of 357 mg/kg/day (rat) in 103-week test (Melnick, 1984).
8. Sublethal effects, non-mammals	0	NOAEC of 2582 mg/l (QSAR calculation).
9. Teratogenicity	6	Muscle and skeletal abnormalities (RTEC, 1981).
10. Mutagenicity	8	Evidence of Sister Chromatid Exchanges (Galloway et al., 1987)
11. Carcinogenicity	0	No increase in tumors in 2-year test by NTP.

APPENDIX C:

PROPOSED AMENDMENTS TO REGULATION 309

1) Schedule 1, NA9305

"The following spent non halogenated solvents: toluene, methyl ethyl ketone, carbon disulphide, isobutanol, pyridine, **2-ethoxyethanol**, and still bottoms from the recovery of these solvents."

2) Schedule 2, Part B, Hazardous waste Chemical,

"**ON2239: 2-ethoxyethanol/ ethylene glycol monoethyl ether**".

ACCO USA
LINCOLNSHIRE, ILLINOIS 60069
#25979
0 50505 25979 3
EXECUTIVE RED/ROUGE EX/R